

CLAIMS:

- ✓ 1. A method of backwashing a membrane filtration system including the step of using permeate remaining present in the system when the filtration process is stopped to provide liquid for backwashing the membrane pores during a
5 backwashing process.
2. A method of backwashing a membrane filtration system according to claim 1, including the step of using a pressurized gas to push the remaining permeate through the membrane pores during backwashing of the membranes.
3. A method of backwashing a membrane filtration system according to claim
10 2, wherein the pressure of the gas applied to the permeate is less than the bubble point of the membrane so that the gas does not penetrate into membrane pores.
4. A method of filtering solids from a liquid suspension including:
- (i) providing a pressure differential across the walls of permeable,
15 hollow membranes immersed in the liquid suspension, said liquid suspension being applied to the outer surface of the porous hollow membranes to induce and sustain filtration through the membrane walls wherein:
- (a) some of the liquid suspension passes through the walls of the
20 membranes to be drawn off as permeate from the hollow membrane lumens, and
- (b) at least some of the solids are retained on or in the hollow membranes or otherwise as suspended solids within the liquid surrounding the membranes,
- (ii) periodically backwashing the membrane pores using the permeate
25 remaining within the lumens by applying a gas at a pressure below the bubble

point to said liquid permeate to displace at least some of the liquid permeate within the lumens through the membrane pores resulting in removal the solids retained on or in the hollow membranes.

5 5. A method of filtering solids from a liquid suspension according to claim 4 wherein during the backwashing step the solids are removed into the bulk liquid surrounding the membranes.

6. A method of filtering solids from a liquid suspension according to claim 5 further including the step of reducing the volume of the bulk liquid before the backwashing step.

10 7. A method of filtering solids from a liquid suspension according to claim 6 wherein the volume of bulk liquid is reduced by suspending provision of said liquid suspension while continuing to provide a pressure differential across walls of said membranes and draw of permeate from the membranes.

8. A method of filtering solids from a liquid suspension according to ~~any one~~
15 ~~of claims 5 to 7~~ ^{claim 5} including the step of removing at least part of the bulk liquid containing the removed solids by a sweep, drain-down or by a feed and bleed process to at least partially discharge the bulk liquid.

9. A method of filtering solids from a liquid suspension according to ~~any one~~
20 ~~of claims 4 to 8~~ including using permeate remaining in ancillaries such as manifolds, headers, piping and the like in addition to that in the membrane lumens as a source of backwash liquid.

10. A method of filtering solids from a liquid suspension comprising:

(i) providing a pressure differential across the walls of permeable, hollow membranes having a liquid suspension applied to the inner surface of the

permeable hollow membranes to induce and sustain filtration through the membrane walls wherein:

- 5 (a) some of the liquid suspension passes through the walls of the membranes to be drawn off as permeate from the outer surface of said membranes, and
- (b) at least some of the solids are retained on or in the hollow membranes or otherwise as suspended solids within the membranes,
- (ii) stopping or suspending the filtration process;
- 10 (iii) periodically backwashing the membrane pores using the permeate remaining after the suspension of the filtration process by applying a gas at a pressure below the bubble point to said liquid permeate to displace at least some of the liquid permeate through the membrane pores resulting in removal of the solids retained on or in the hollow membranes.

15 11. A method of filtering solids from a liquid suspension according to ~~any one of claim 4 to 10 including~~ providing a further chamber or reservoir in a permeate flow circuit to increase the amount of permeate available for backwashing when filtration is stopped or suspended.

12. A method of filtering solids from a liquid suspension according to ~~any one of claims 4 to 11 including~~ the further step of scouring of membrane surfaces by
20 flowing gas bubbles past the membrane surfaces.

13. A filtration system for removing fine solids from a liquid suspension comprising:

- (i) a vessel for containing said liquid suspension;
- 25 (ii) a plurality of permeable, hollow membranes within the vessel;

(iii) means for providing a pressure differential across walls of said membranes such that some of the liquid suspension passes through the walls of the membranes to be drawn off as permeate;

(iv) means for withdrawing permeate from the membranes; and

5 (v) means for applying gas at a pressure below the bubble point to the liquid permeate within the system and the membrane lumens to affect a discharge of at least some of the liquid permeate in the lumens through the membrane walls to dislodge any solids retained therein and displace the removed solids into the liquid suspension surrounding the membranes.

10 14. A filtration system according to claim 13 wherein said membranes are mounted in a number of membrane modules and the membrane modules are used in a bank and connected to a manifold for distributing liquid suspension to and removing permeate from the system.

15 15. A filtration system according to claim 14 wherein the gas is introduced into the manifold of the bank of modules so that permeate within the manifold is utilized for backwash.

16. A filtration system according to any one of claims 13 to 15 further including means to reduce the volume of liquid suspension in the vessel before the backwash so as to reduce the backwash waste volume.

20 17. A filtration system according to claim 16 wherein the volume of liquid suspension in the vessel is reduced by suspending flow of feed to the feed vessel while continuing to provide a pressure differential across walls of said membranes and withdrawal of permeate from the membranes.

18. A filtration system according to claim 17 wherein the pressure differential
25 across walls of said membranes is obtained by application of a pressurized gas.

- 15 -

19. A method of cleaning a membrane filtration system including the step of providing gas or gas bubbles within a vessel containing the membranes during a sweep or drain down of waste containing liquid from the vessel during or following a backwashing, scouring and/or cleaning step.

5 20. A method according to claim 19 wherein the sweep or drain down step is partially or fully performed with a liquid backwash step.

21. A method according to claim 19 or 20 including the step of applying a pressurized gas to the waste containing liquid to assist removal of the liquid from the vessel.

10 22. A method according to claim 21 wherein the sweep or drain down step is partially performed with the liquid backwash step and a further sweep or drain step is performed following the liquid backwash step.

23. A method according any one of claims 19 to 22 including a step of flushing waste containing liquid from the vessel using feed liquid.